$\not\!\!E_T$ Trigger Performance

- Introduction
- LVL1 Trigger Performance
- Comparison to HLT Trigger
- Summary

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1

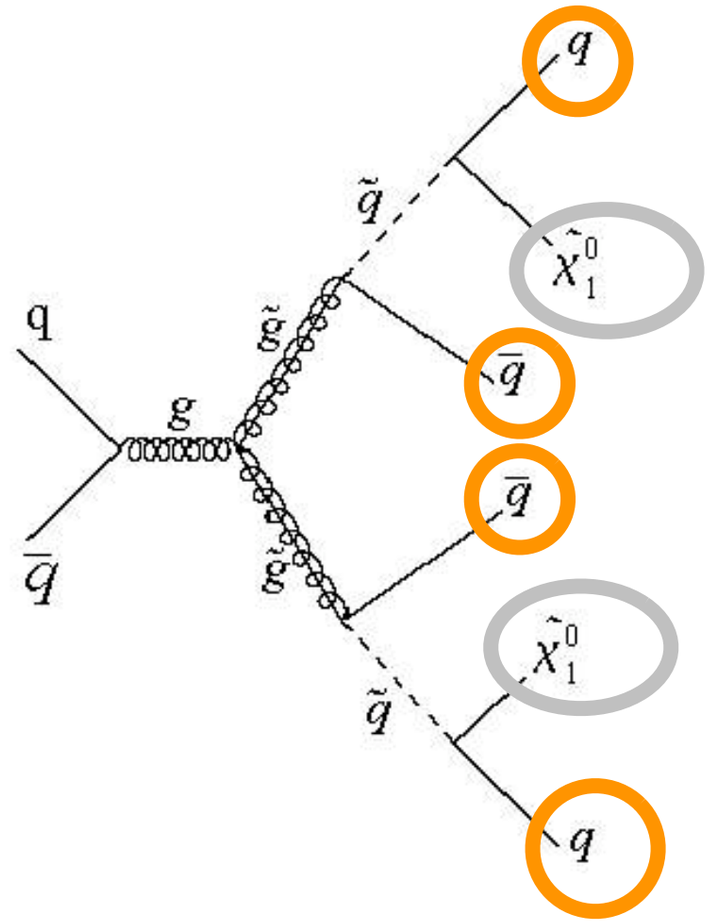
Sources of $\not{E}_T$ signatures (1)

$\not{E}_T$ is an important signature for new physics!

Physic signatures:

- mSUGRA:
  - R-Parity conserving → LSP
    I.e.: $pp \rightarrow \tilde{g}\tilde{g}+X \rightarrow Jets + \not{E}_T+X$
  - R-Parity violated → Neutrino.
    I.e: $X_1^0 \rightarrow l^+l^-\nu$
- Standard model → Neutrino
  I.e.: $W \rightarrow e\nu$

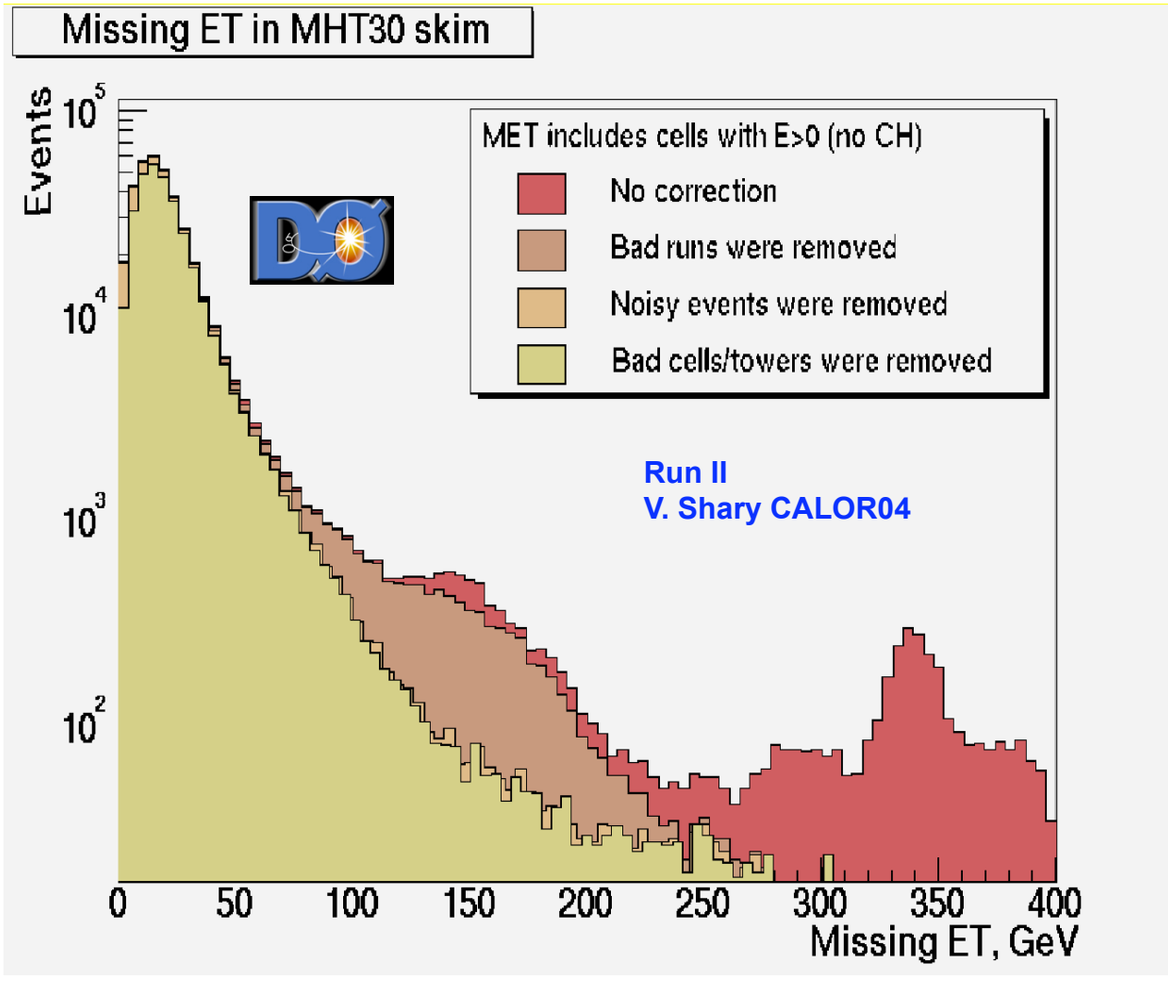
I.e.: mSUGRA decay chain



Sources of $\not\!\!E_T$ signatures (2)

$\not\!\!E_T$ is not a local „object“ variable

- Detector acceptance (cracks)
- Hot cells
- Noise (coherent)
- Beam background
- Pit background



High $\not\!\!E_T$ performance highly not trivial!

$\not{E}_T$ Calculation at trigger level

Different approaches for the $\not{E}_T$ Calculation at trigger level:

LVL1:

- ~7200 EM & Had trigger tower ($\Delta\eta^*\Delta\Phi$ = 0,1*0,1)
- Only calorimeter information is used

LVL2:

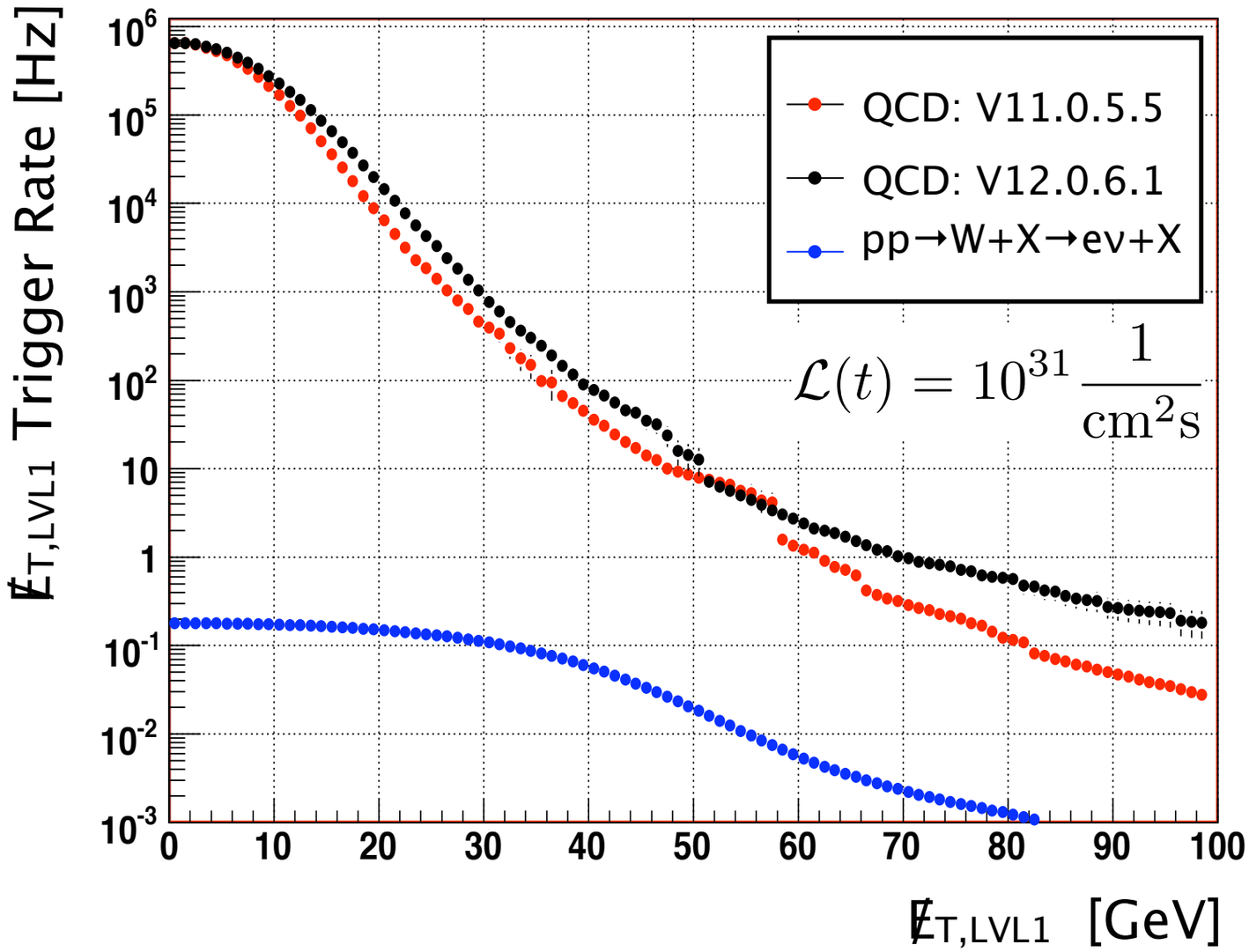
- Need Muon on LVL2
- Apply correction for the Muon p_T to LVL1 $\not{E}_T$

EF, 2 Method available:

1. Loop over all calorimeter cells and recalculate $\not{E}_T$ (default)
2. FEB sums are used to recalculate $\not{E}_T$

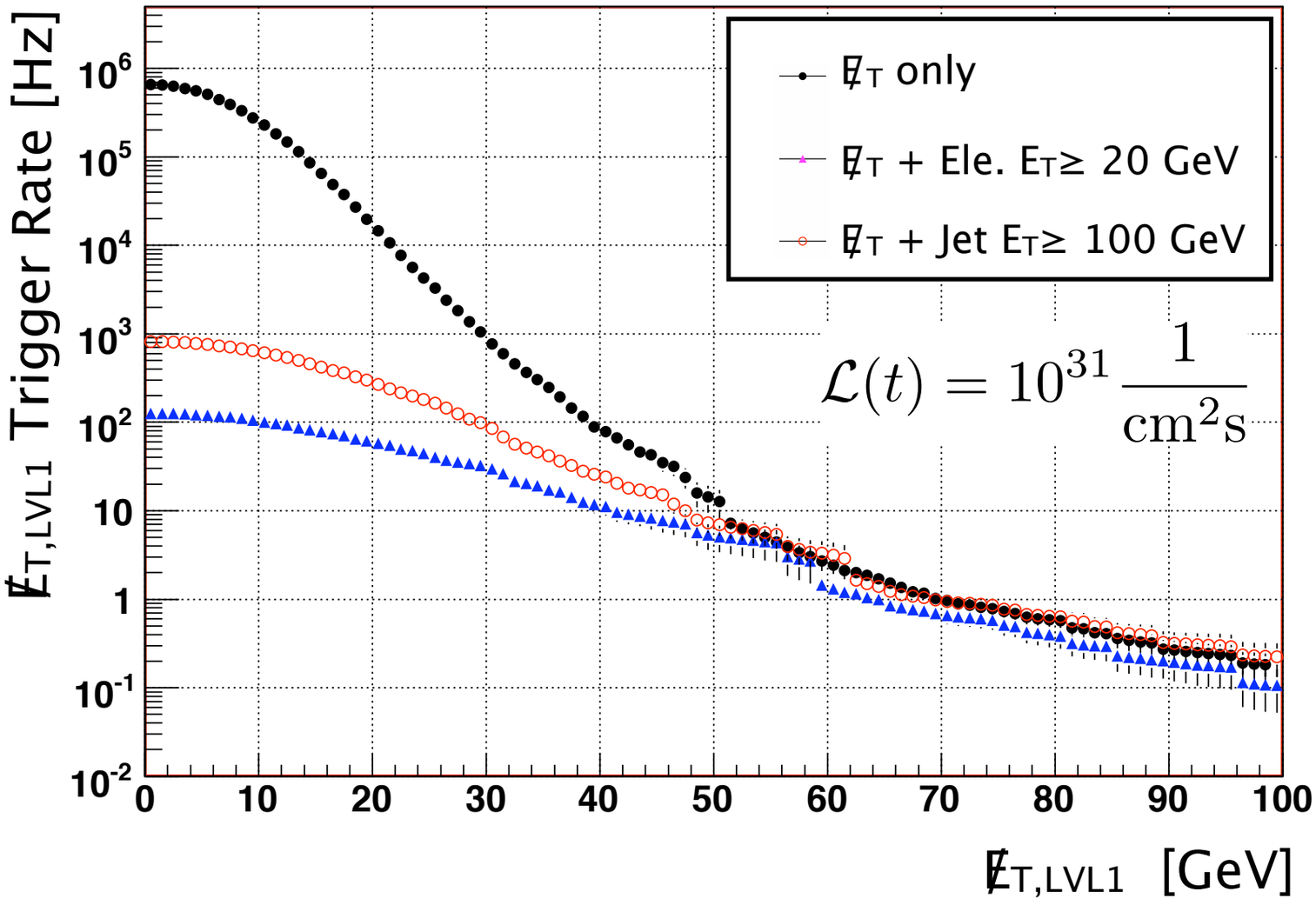
HLT

Inclusive LVL1 $\not\!\!E_T$ trigger rates



- Compare Athena Ver. 11 & 12:
  - $\not\!\!E_T$ rates change up to a factor 7
  - Changes
    - Generator
    - Detector geometry
    - LVL1 Simulation
  - Biggest contribution from: Generator (Pythia):
    - Version: 6.3 → 6.4
    - Parton shower simulation
    - Underlying event generation
  - Note: no PileUp simulation included

Less inclusive LVL1 $\not{E}_T$ trigger rates



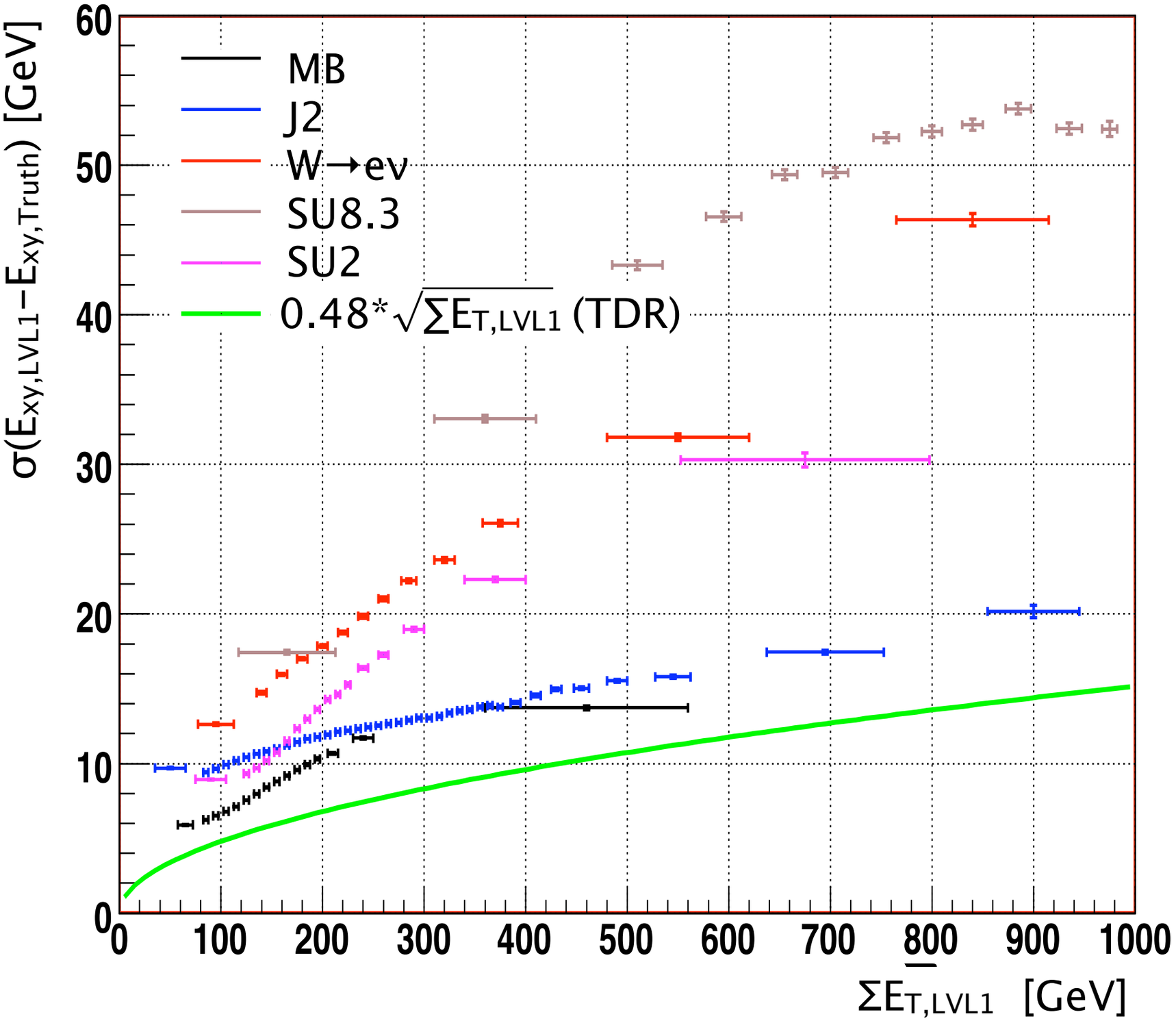
- Motivation:
  Have a physics channel with more than one physics object
- Problem:
  Rate too high for incl. trigger

➡ Reduce Rate by using less inclusive trigger

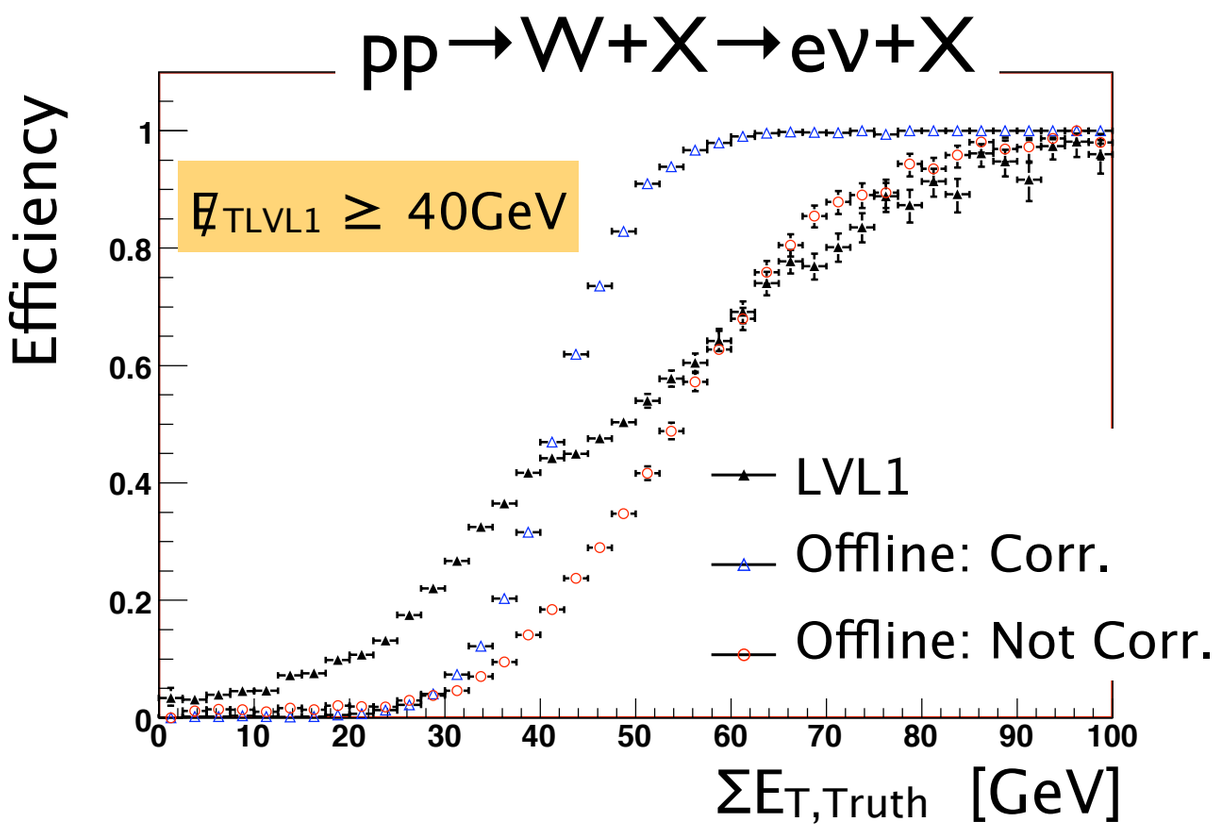
- But: keep Selection efficiency for the physics channel
- Example of Signature:
  - $\not{E}_T$ + Jet: Jet $E_T \geq$ 100 GeV
  - $\not{E}_T$ + Ele: Ele $E_T \geq$ 20 GeV (not isolated)

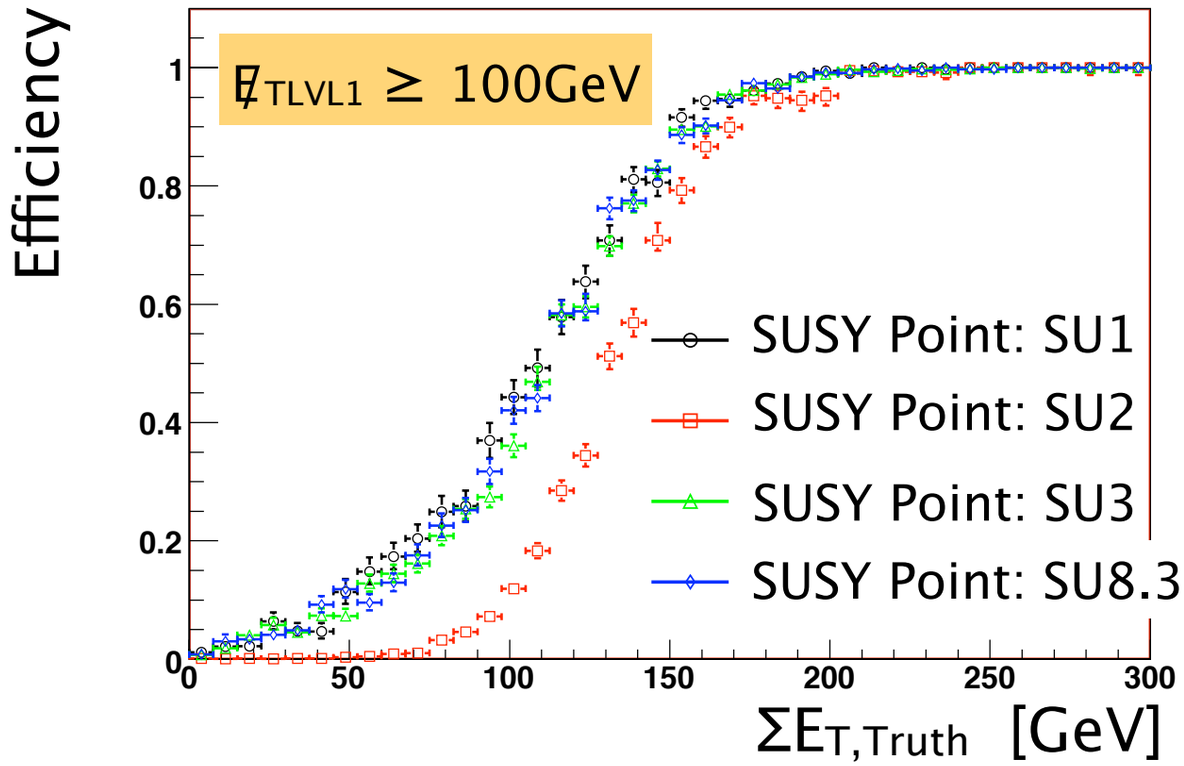
LVL1 $\not\!\!E_T$ resolution $\Sigma E_{T,LVL1}$

- $\not\!\!E_T$ is not a directly measured observable
- $\sigma(E_{x,y})$ calc.: Truth info. from interacting particles used
- $\not\!\!E_T$ resolution dependence on the topology of the physics process
- SUSY Points: contains lot of different decay chains



LVL1 $\not\!\!E_T$ trigger efficiency





- Efficiency for: pp→W+X→eν+X
  - Problem: LVL1 turn on curve shows substructure
  - Detailed studies: Problem in the hadronic energy scale
- SUSY: Slope of the turn on curve depends on the SUSY parameter point

Before using LVL1 $\not\!\!E_T$ trigger: energy scale has to be understood

Comparison to HLT: $\not{E}_T$ rate & resolution

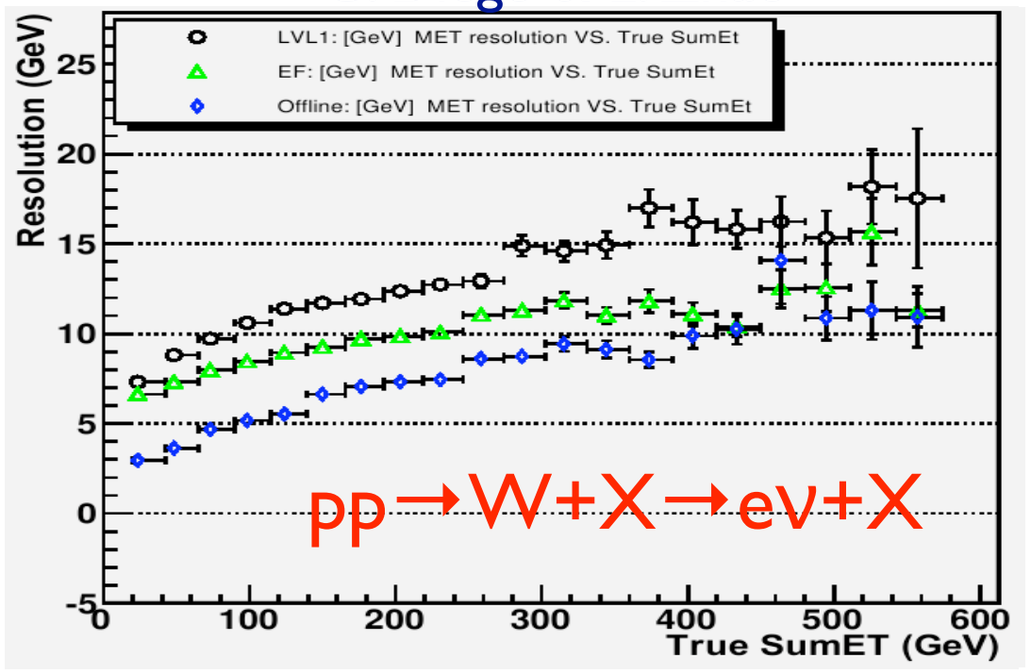
- Compare LVL1 & HLT $\not{E}_T$ Rates

Threshold [GeV]	Rate [Hz] LVL1	HLT
20	10500	~15000
50	10	~0.2
80	~6	~0.02

➡ Efficient rate reduction for higher $\not{E}_T$ values

- Resolution (EF):
  - Looks ok (use cells).
- Bias:
  - not negligible
  - not yet understood, work in progress

C. Diego & L. Zhao



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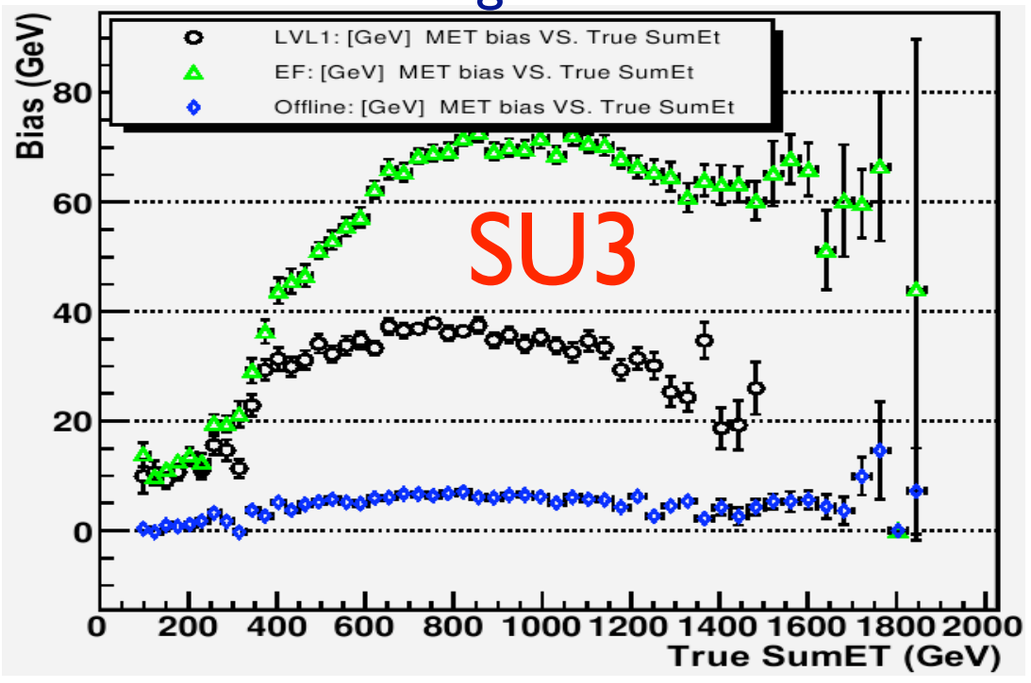

Summary

- Source of $\not{E}_T$ signatures comes not only from the topology of physics process
- $\not{E}_T$ is not a local „object“ variable
- $\not{E}_T$ resolution depends on the topology of the physics process
- $\not{E}_T$ calculation: HLT include muon P_T, LVL1 not
- HLT:
  - Efficient rate reduction wrt. LVL1
  - Bias in $\not{E}_T$ resolution is not negligible

Don‘t believe we have a good $\not{E}_T$ trigger from day 2